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Microorganisms in Everyday Life

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Ecology in High School

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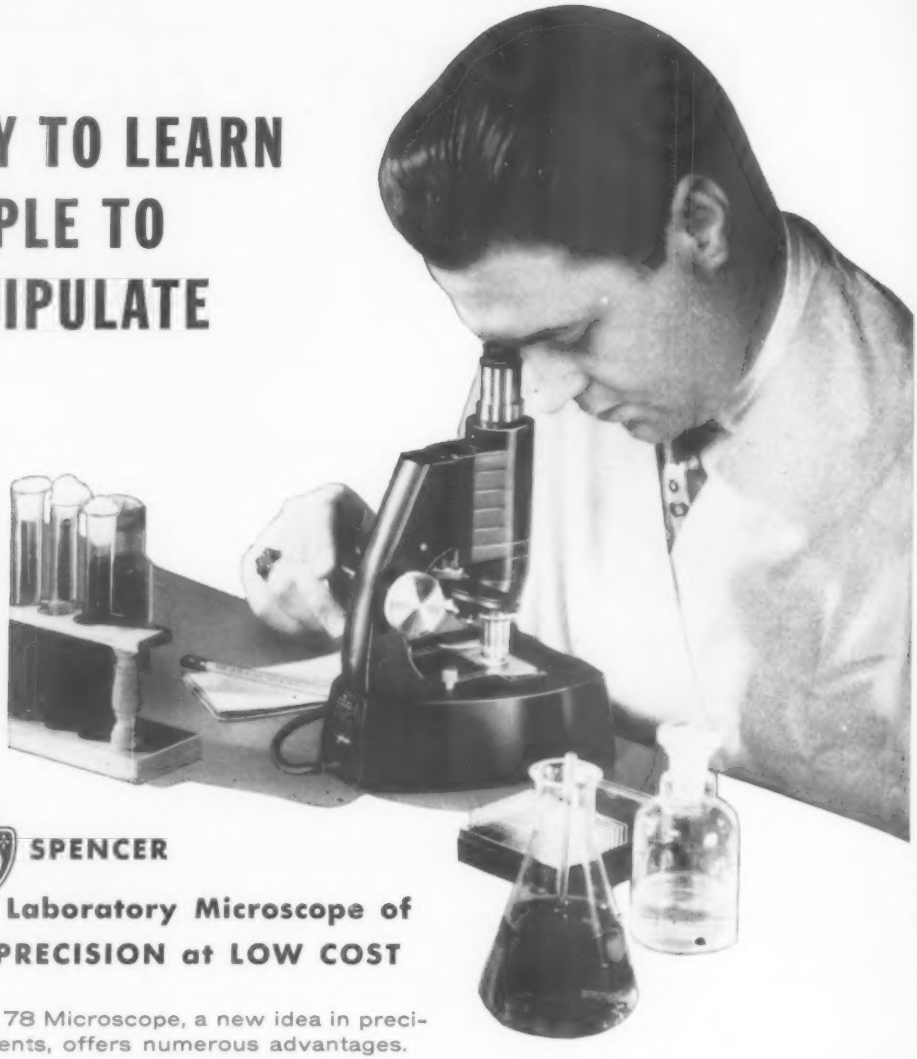

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Teachers and students are invited to send in photographs to be used on the cover of future issues of THE AMERICAN BIOLOGY TEACHER. Please enclose brief description along with each picture.

Cover Photograph

One of the early flowers of Spring, Sanguinaria canadeusis, Bloodroot. Photograph by A. T. Guard, Department of Biological Sciences, Purdue University

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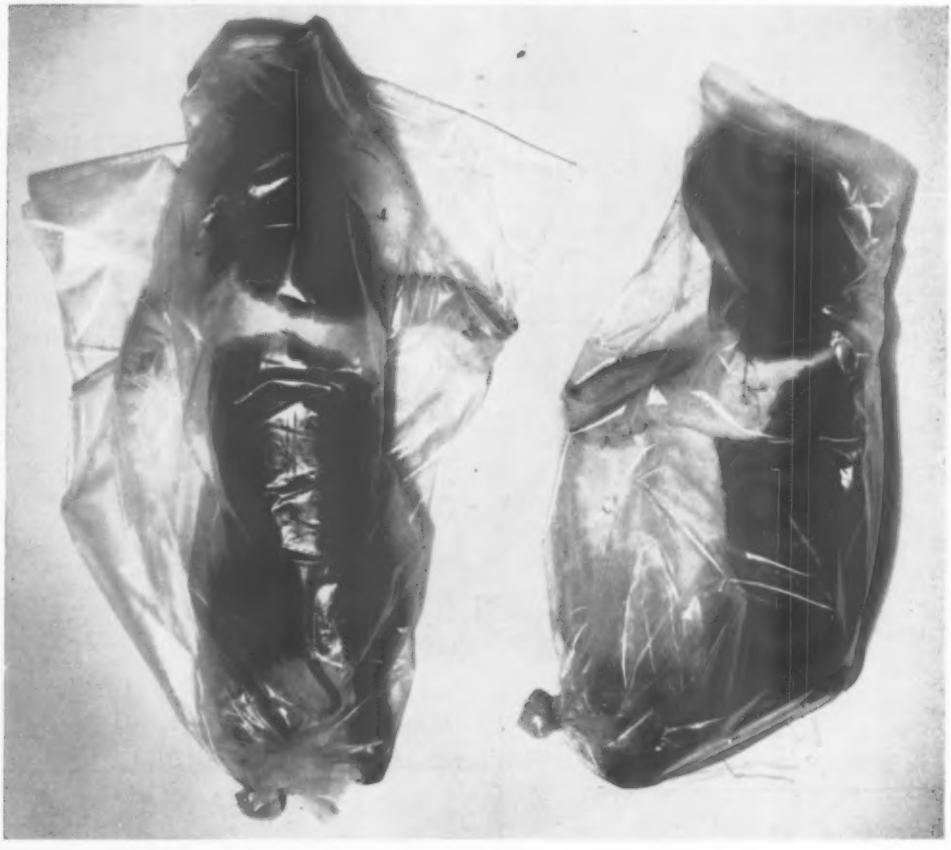

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Microorganisms in Everyday Life[1]

H. B. WOODRUFF
Director of Microbiological Research
Merck and Company, Chemical Division

Several years ago a famous Cornell University microbiologist took a census of the bacteria. The task was a formidable one. Once every ten years the 150-odd million Americans are counted by several thousand full-time employees. The world population, estimated at two billion people, never has been counted accurately. The Cornell microbiologist successfully enumerated the bacteria of the world, totalling over ten septillions (10,021,109,000,000,000,000,000,000). Moreover, he separately counted the number of pathogenic bacteria and non-pathogenic or useful, bacteria. He showed that there are two hundred thousand times as many useful bacteria in the world as there are pathogenic bacteria.

Despite this disparity in numbers, it is the pathogenic bacteria which provide work in the glamorous professions. The activities of doctors, nurses, and the microbe hunters are well known to high school students. Principles of public health are taught in biology courses and in Red Cross courses, are practiced by the family doctor, and published in the newspapers. A champion for the numerous, but less popular, useful bacteria is difficult to find. This summary is presented to provide a basis for informing students about our useful bacteria.

Each time we drink a lemon soda we are partaking of a bit of citric acid. Citric acid, originally isolated from spoiled citrus fruits, now is manufactured almost exclusively by a common black mold called *Aspergillus niger*. Over fifty million pounds per year is produced in the United States alone. When we have a sandwich containing Lebanon Bologna, the characteristic flavor depends on the growth of a microorganism called *Pediococcus*. We like sauerkraut with our spareribs, but without a bacterium, *Lactobacillus*, sauerkraut could not be made. If we have a salad with our meal, the vinegar in the dressing is furnished by the oxidative activities of a small microbe on apple juice. Our grandmother baked bread and other raised-dough cakes with the aid of the yeast cake which she bought at the corner grocery store. Today, the city baker does our baking, but the small microorganism, *Saccharomyces*, still does the work for him by producing carbon dioxide gas to raise the dough. The value of microorganisms in furnishing us food will become apparent if you but stop to think a moment.

There are other activities of microorganisms equally useful, but less well known. When we have a cold or a stuffy nose, we run to the medicine cabinet for nose drops or for an inhaler. These medicants frequently contain ephedrine or ephedrine derivatives which shrink the nasal mucosa, thereby providing symptomatic relief for our distress. One step in the manufacture of ephedrine is carried forward by a microbe, a close relative of the bakers' yeast.

Sailors on the Spanish galleons and English men-of-war were fed fresh vegetables, lemons, and citrus fruits; but after many days at sea, when fresh food was gone and only the staples were left, the sailors developed scurvy, became ill, and sometimes died. People on shipboard today do not suffer this disease for we know that a vitamin called ascorbic acid, or vitamin C, will prevent the dreaded disease. The manufacture of vitamin C is initiated by a chemical reaction carried out by a small bacterium called *Acetobacter*, a close relative of the bacterium which manufactures vinegar for our table. The "golden vitamin," riboflavin, which promotes growth of children is referred to as a supplement in practically every breakfast cereal. This vitamin is the manufactured product of another yeast-like mold called *Eremothecium*. The "red vitamin," vitamin B_{12}, which overcomes pernicious

[1]Contribution from the Merck, Sharp & Dohme Research Laboratories; Merck & Co., Inc.; Rahway, New Jersey.

anemia and is the active component of liver extract, is synthesized by a bacterium called *Streptomyces*.

Cortisone and hydrocortisone, commonly known hormones, used in treating rheumatoid arthritis, are manufactured products of useful fungi, a group sometimes called the water molds.

All of these pharmaceutical products—vasodilators, vitamins, hormones—are valuable microbial products worth millions of dollars in money and are of untold value in overcoming human suffering. However, the most valuable products of all those derived from microorganisms, in terms of human value, the saving of human lives, and in terms of dollars spent and dollars returned, are without question the antibiotics.

The term antibiotic has become common in modern medicine. Most of us have had contact with penicillin, Aureomycin, Terramycin, or some other antibiotic drug. Although familiar with what antibiotics do, many people do not realize that the definition of the word antibiotic is limited with respect to the source of the drug. An antibiotic is a substance produced by a useful microorganism which is employed to destroy a disease-producing, or pathogenic, microoganism.

Despite the widespread use of antibiotics in medicine, there are less than twenty useful antibiotics available to the doctor today. Yet, over four hundred antibiotics have been named and are described in scientific literature. It is obvious that only a very few of the antibiotics discovered actually find ultimate use in human medicine. Toxicity, or other unfavorable properties, rule out the use of most antibiotics. When it is realized how many antibiotic-producing microoganisms must be isolated, and how many antibiotics must be studied before a successful compound is discovered, it is apparent immediately that tremendous numbers of research hours must be spent for each medical advance in the area.

It is fortunate that we have the trillions of useful microorganisms available to us. Because of this great number we have confidence that additional new, useful antibiotic-producing microorganisms will be discovered. Their products will be of use in those diseases which have not succumbed yet to antibiotic therapy, or in those diseases which are becoming resistant to treatment with the known antibiotics.

Our Cornell University microbiologist's census opens wonderful potentialities for future work with microorganisms. The large numbers involved mean that the numbers and variety of useful microorganisms yet undiscovered and yet unstudied provide ample opportunities for all who wish to enter this field for many years to come. We need not be worried by competition; where an interesting microorganism may be found today, an even better one exists to be found tomorrow.

We do need new students who will be trained to aid us in the discovery of new antibiotics, just as we need new investigators who may discover entirely new applications of microorganisms.

The high school or introductory-level college biology teacher has a significant opportunity in explaining the useful activities of microorganisms to students. Only by being brought face to face with some of the activities of these microorganisms, by realizing how closely they touch everyday life, is it possible for an awareness to be borne in the student which may lead eventually to significant contributions by him in the field of microbiology.

The desire of the student to enter the medical profession or the nursing profession is natural because of the student's contacts with the needs for such a profession in his daily life. In contrast, investigation of the useful activities of microorganisms, making them do our bidding to produce new products for mankind, is often undertaken in a haphazard manner. A nearby pharmaceutical house may serve as a stimulus for advanced biology students in the secondary schools or college of the locality. All too frequently, however, workers in the productive aspects of microbiology must be drawn from chemists, engineers, biologists who learn the romance of their undertaking only after they actually have become engaged on a specific problem in the field. Those of us who have learned how fascinating work with the useful microorganisms can be have become self-appointed ambassadors of good will for them. We feel that it is our duty to tell others of the interesting aspects of microbes, and thus to make converts who can learn more about

these microorganisms and can show us ways in which we shall be able to take additional advantages from their activities.

One learns to know microorganisms by observing the things they do. Here, the biology teacher can aid greatly in promoting knowledge among his students by seeing that they experience something of the activities of these small plants and animals. Experiments with them need not be complicated. It is true that an autoclave, a dry-heat sterilizer, microscopes and other expensive equipment are needed in teaching the science of bacteriology. These are available to the college student, and he can be shown something of the useful microbe world, if his professor will but take the time to select the right laboratory manual and to prepare the laboratory demonstrations.

In the secondary school, however, such equipment is not a necessity. The high school teacher can substitute originality for more expensive facilities and still show the place of microorganisms in our everyday life. One can induce easily a mold to convert sugar solution to citric acid in the classroom, without benefit of aseptic techniques. By taste, the student can follow the sweet flavor of the sugar as it decreases and note the tart flavor of the acid appear. Dough can be raised on top of a radiator and the necessity for the yeast cake quite simply proved. The phosphate content of soil, which is a measure of its fertility, can be demonstrated readily by mixing the soil with a sugar solution, pressing it into mud pies, and inoculating a few mold spores on the surface of the patty. The relative size of the mold colony is a measure of soil fertility, and is comparable to the growth to be anticipated by plants from different soils.

With a bit more care, the requirement of clover, peas, or beans for symbiotic bacteria, to make rapid growth, can be shown by growing these plants in liquid culture, pasteurized by boiling. A nutrient solution containing all of the necessary elements except nitrogen will promote poor growth of a legumious plant; whereas, plants in a similar solution, inoculated with a bacterial culture of legume bacteria obtainable from a local seed store will fix atmospheric nitrogen and show excellent growth and obvious nodule formation on the roots.

Even the synthesis of vitamins can be demonstrated easily. There are certain green algae which will grow only in the presence of vitamin B_{12}. These algae will grow in salt solutions in the presence of sunlight, provided a source of vitamin B_{12} is added. By preparing two flasks of salt solution, one containing no supplement and the other supplemented with a small amount of hay infusion which has been heavily overgrown by the natural bacteria, vitamin synthesis is indicated by the fact that algae will grow and make heavy green coloration in the flask supplemented with hay infusion, and essentially no growth in the control flask.

It is possible even to demonstrate the production of antibiotics by microorganisms without special equipment, although such demonstrations require careful attention to technique. Gelatin, pasteurized by boiling and allowed to solidify in a Petri dish previously sterilized in the household oven, will support growth of *Bacillus polymyxa*, an antibiotic-producing bacterium. By streaking the bacterium in a line across the gelatin, allowing a day or two for growth at room temperature, then cross-streaking with a dilution of feces, or some representative bacterium, sharp inhibition of bacterial growth in areas near the *Bacillus polymyxa*[1] will be observed. The antibiotic responsible for this phenomenon is polymyxin (Aerosporin), a member of the doctor's arsenal against disease.

To be successful in his aim, the biology teacher must have imagination and a real desire to give his students a well-rounded microbiological education, rather than the usual narrow treatment of disease bacteria. The result will be the unfolding of a fascinating new world for his students. Above all, the Pasteurs, the Flemings of the future will be led at an early age to a field where much still remains to be accomplished for the good of mankind.

[1]Cultures mentioned here are obtainable from the American Type Culture Collection, 2029 M. Street, N.W., Washington 6, D. C., and can be purchased for each use.

There is available from the National Research Council, 2101 Constitution Ave., Washington 25, D.C., an *Annotated Bibliography of Literature on Careers in the Biological Sciences*, published July 1955. Teachers will find this an important list of material on biological vocational information.

Ecology at the Beginning of a High School Biology Course

IRENE HOLLENBECK,
Southern Oregon College of Education,
Ashland, Oregon

The author has been using a unit on ecology as an introduction to the high school biology course for the last ten years. Each year it has met with an enthusiastic reception. Since getting first hand knowledge of living things is one of the earliest experiences a beginning biology student should have, we begin the unit with a field trip, end it with a field trip, and in between take as many trips as the weather permits.

Our most interesting introductory field trip came up quite by accident one year while we were discussing summer vacations during the first week of school. Some of the boys had been on fishing trips, and naturally, other student anglers asked about their success. Replies varied, but the question of good catches or poor seemed to depend upon whether or not the stream or lake had been stocked. One boy was puzzled enough to remark: "Mill Stream is stocked each spring with 6 inch trout but we haven't caught a fish there all summer. Why?" Of course I didn't know, but I suggested there might be ways we could find out—it might involve a few field trips, we might even have to go wading in Mill Stream. Students were enthusiastic immediately, so we set up our first problem: "Why is trout fishing so poor in Mill Stream?" The class became involved in a discussion of trout life processes and a consideration of the environmental factors important to the survival of trout. We listed these factors and decided how they might be measured before we set off on our first trip.

The next day squads of students consisting of a captain, recorder, and crew were assigned to stations along the stream. They measured the temperature of the water and of the air, timed the speed of flow by tossing in a stick and watching it for a measured distance, estimated the depth of the water, and observed its color, and transparency. The kind of banks and the type of stream bed came in for a share of attention. Were the banks sloping or vertical? Were they covered with plant life? Did the plants shade the stream? What per cent of the stream bed was covered with mud or sand or gravel, and what part of its area was covered with emergent or floating plants? Attention then turned to a closer observance of the plants and animals. Those which could not be collected were observed by the recorder—relative abundance, where found—under rocks, on the surface, free swimming, or attached to vegetation or other supports. Observations were also made of what the animals were doing, what they were eating, manner of moving, and so on.

Back in the laboratory we set up aquaria, compiled our data and discussed our findings. We had learned something about our own stream but we still didn't have an answer to our question since we did not know what conditions were present in streams where trout fishing was good. To get this information one student volunteered to visit his favorite stream and bring back a report. Another interviewed a local fishing authority and several went to the library to get information on the food habits and other environmental needs of trout. Finally a motion picture, "The Trout Story," filmed in Oregon by the Oregon State Game Commission was shown to the class. With all these sources of information we had a partial answer to our question—our stream was warmer, had less oxygen, and provided less food than the other streams. Besides that, it was full of trash, most of it tossed in by the students themselves, since it is a stream that cuts across the campus.

We had something else besides an answer to our question—we had an awakening of interest in the living things around us, a dawning of the interrelationships of many living things. In following years this became a very popular field trip for we made an annual check of the animal and plant populations and compared it with the data obtained in preceding years.

By the time we had completed this first problem, the students had discovered that note-taking on field trips would be easier if they knew the names of the plants and animals. Writing our descriptions or hunting up the teacher for identification of animals or plants got to be rather tiresome so the time was ripe to teach the use of a simple key.

To develop this problem we started by constructing a key to the trees on the campus, based on leaf forms. In doing so we learned something about leaves and learned to "look" as well. This home-made key was then used to identify the trees on the campus and in a nearby park. On another field trip we collected and classified arthropods and in the laboratory the following day used a key to place the insects in orders.

With this new skill we were ready for another ecological field, this time to a terrestrial plant and animal community. The students were given a map of an oak grove on the edge of the campus on which eight stations were marked. A mimeographed set of directions told the students what to study at each station. At one station they looked for nodules on the roots of the clover plants and studied the stages in the life cycle of a parasitic wasp by opening up the galls on the oak leaves; at another they found mildew on leaves, bracket fungi on a rotten log, lichens, moss, and insects on the trees and many other evidences of plant and animal interrelationships. The fungi which were very abundant on this trip provided us with good first-hand knowledge for our discussion the following day and a good introduction for a field trip to an industry where fungi were of commercial value.

At one of the largest mushroom farms in the west, we learned that horse manure and straw were used for compost because it had high bacterial count, that the beds and soil were sterilized, and that a constant watch must be kept to keep out disease and parasites. Here we found an entirely different set of environmental factors: darkness, high humidity, uniform temperature, and we had a good look at the mycelium. With the owner we discussed the food value of the fungi and their perishable quality.

After the students were familiar with the insects, fungi, and plants on or near the campus they were ready for a half day at a "Wooded Laboratory." On this field trip to a nearby state park in a beautiful Douglas fir forest we found a quite different plant and animal community. From a position at the brink of the falls where a trail winds down into a canyon we could look off across the tree tops and study the forest by means of our guide sheet which started off with this question: "Did you know that a forest was made up of layers: See for your self——" Directions for investigations of all the layers followed. During the afternoon students gathered evidence that helped to answer such questions as: "Would this forest provide good food for deer?" "Why did we see more birds on the edge of the forest than down in the canyon?" "What evidence do you find that man is one of the worst enemies of this forest?"

A hike along the trail that passed under the water falls gave us a chance to study plant succession on the cliff and to observe the ferns that grow where there is a constant supply of moisture, and to taste the rhizomes of the licorice fern and wild ginger. An examination of the trash, duff, and soil layers brought out other interesting facts about our forests. Finally, each group of students selected a certain habitat for an independent investigation or exploration—the pool, at the base of the falls, a swamp, a rotten log community, a rocky ledge. It was interesting to hear them set up their problems and make their plans. Conversation on the school bus on the return home was also interesting. Students were more alert to the forest through which we were driving, the plant sucession in a burned over area, the cover provided by fence rows, and the conservation practices of the farmers along the way.

Although this field trip was usually the culmination of the unit on ecology our study

did not end there. After the first snowfall a trip was made to our oak grove to observe it under winter conditions. Still another trip was made in the spring when the trees were in flower. Many of the students went on self-guided field trips in groups or with their family using a sheet provided by their teacher.

One such all day trip was made by a small group with the teacher for the purpose of studying the changes that were taking place along a mountain stream. We looked for evidences of flood, soil erosion, deforestation, and good conservation practices. At a dam that was under construction we made inquiries about the influence it would have on wild life along the river, how it would help in flood control, and what provisions were being made to care for the migrating salmon. After lunch at a forest camp we stopped at a salmon fish hatchery where we learned something of how and where the eggs were obtained, the conditions necessary for hatching, and the disease and other factors that reduced the number of fish. On the return home we stopped at an area recently hit by a forest fire to see what evidence of plant and animal life we could find.

Our most interesting spring field trip, however, was one to the Oregon coast where the environmental factors were entirely different from those of any other area studied. Animals found on a rocky shore at high tide line were quite different from those on the sand beach at the high tide line. Those in the deep tidal channels were adapted to a different set of environmental factors than those on exposed rocky reefs. We found that one of the best places to look for animals was under rocks, and by now, no one needed to be told that every rock must be replaced lest its environment be so changed that animal survival was impossible.

This field trip, like all the others, was planned by members of the class, and was followed by as many days of laboratory work and class discussion as were necessary to develop the understandings and principles underlying the trip.

Though field trips are by far the most important part of a unit on ecology many other activities occupied our time. On maps of Oregon the national forests, game refuges, fish hatcheries, fishing streams and lakes, dams, and bird sanctuaries were located. Collections of helpful and harmful insects, lichens, fungi, galls, and adaptations were exhibited; reports on plants and animals of other regions such as the desert, deep sea, and arctic were made; and movies that would help tell the story of the interdependence of plants and animals were frequently shown.

High school students are enthusiastic about this kind of biology. They develop a curiosity and interest in living things they could never get from textbooks alone, and an understanding of interrelationships and fluctuations in a community that can only come from outdoor study.

Organisms so tiny the human eye can't see them have proved a big help to chemists trying to find out how the human eye works, reports Dr. J. J. Wolken of the University of Pittsburgh Medical Center. The one-celled organisms, called algal flagellates, are being studied with the electron microscope, the spectroscope, and radioactive tracers—and they are yielding important new information about "light reactions," or chemical processes promoted by the action of light, reported Dr. Wolken, who is director of the new biophysics laboratory of the Eye Bank of Pittsburgh. Light reactions include chemical processes taking place in the retina, in the leaves of green plants, and in certain industrial chemical procedures. The chemistry of the retina of the eye, involving vitamin A is familiar to biochemists, Dr. Wolken noted, but the chemical and biological processes which translate the image on the retina into a picture in the mind are yet to be explained. The current studies of the photosynthetic processes of algal flagellates, he asserted, are helping to solve such mysteries.

Because houseflies have a "sweet tooth," they can be safely and easily controlled even when they don't succumb to DDT, report J. B. Gahan, H. G. Wilson and W. C. McDuffie of the United States Department of Agriculture. All the farmer need do is lightly sprinkle some "loaded" sugar on the floors of his barn and chicken house, using a pint jar with some holes punched in the top. The insecticides mixed with the sugar—malathion, Diazinon or Bayer L 13/59—have proved effective even in concentrations as low as one-tenth of one per cent, according to tests made by the Bureau of Entomology and Plant Quarantine at Orlando, Florida.

Why Fear a Snake?

BROTHER EMILIAN VICTOR, F.S.C.[1]
La Salle College—Anselm Hall.

Deceptively thin and small is the ten foot African Rock Python shown above. It is actually about twice as thick as the biceps of the individual holding it. Note that it is being held not only by the neck, but also at the anal plate. Do you know why?

Timidity can be overcome by proper training. The author here gives a novice herpetologist her first snake.

Throughout the ages, the snake has been an object of extreme curiosity. Lack of proper knowledge and a fear planted by others have changed this normal, healthy curiosity into a state of morbid attention for the greater part of youth. Those who know snakes for what they really are, feel that the greater portion of these animals have been condemned without a fair trial. To the ordinary layman, the snake is a very dangerous animal; it is incapable of ever becoming a friend of man and is something to be killed on sight in order to make the world safe. To the man who knows, the snake can become very docile, and will make an interesting pet. Records show that a great portion of snakes are rodent eaters and slow to approach a human being. Of course, if you irritate a snake, it may retaliate vigorously.

The temperament of snakes is varied, but in general it is very good. Such snakes as the Boa Constrictor, the Indian Python, the Indigo, the Pilot Blacksnake and certain Rattlesnakes (poisonous), are tameable and make good pets (only the experienced should keep venomous snakes in their collections). The Cuban Boa, the Tree Boa, and to name some poisonous specimens, certain Cobras are very difficult to tame and usually remain hostile. I have yet to find a specimen, once tamed, strike without warning or provocation. They maintain their docility throughout captivity.

The sizes of most snakes have been greatly exaggerated, the largest serpent probably being the Regal or Reticulated Python of Burma

[1]The author wishes to thank Mr. Clifford H. Pope as well as Doctors John S. Penny and Roland Holroyd for their many helpful suggestions.

and Indo-China. This snake attains a length somewhat in excess of thirty feet. Such large specimens, however, are rare. The Anaconda (twenty-eight feet or more) and the Indian Python (twenty-five feet) are also very large. In the United States, the Indigo or Blue Bull Snake (eight feet) and the Pilot Blacksnake (eight feet) are two representatives of our big snakes.

Nutrition in snakes forms an interesting study. All serpents swallow their prey whole, without chewing. The arrangement of the jaws permits extension of the throat to an amazing degree. The bones of the lower jaw are not directly connected in front, but are held together by an elastic ligament. This and other peculiarities of structure permit expansion. Food is varied, although most snakes prefer a certain type of diet. Blacksnakes and Corn Snakes, for example, prefer rodents such as rats and mice, while the Hog-nosed Snake feeds almost exclusively on toads and frogs.

No snake can swallow a man, although some of the larger specimens have been known to swallow pigs, deer, and other large mammals. It is possible, however, for the larger constricting snakes to kill a well-developed human being, though they rarely do so.

HARMLESS SNAKES

Did you ever stop to take a good look at a Corn Snake? Did you ever stop to take a good look at any harmless snake? If you did, you would have noticed certain peculiarities which snakes alone exhibit. The most startling for you might be their movement. No legs, arms or other external appendages can be seen, yet the serpent glides effortlessly across its cage. Perhaps its tongue, forked and continually flicking in and out without the mouth being opened, causes you to pause. (Lizards also flick out the tongue, so that this is not, strictly speaking, a habit peculiar to snakes.) No matter how closely you look, you will not find external ear appendages. These and many other facts make herpetology not only educational and beneficial, but enjoyable as well.

Let us explore a few false theories of snake-lore. Snakes do not poison their prey with the tongue. This organ is completely sensory, having nothing whatever to do with venom. Serpents possess two small pits in the front of the roof of the mouth called "Jacobson's organ." It is known that these pits are outgrowths of the nasal region. Jacobson's organ is therefore important as an organ of olefaction. The delicate tips of the tongue convey particles of matter to this organ, where a chemical reaction, the exact nature of which is not clear, takes place, and the process of smelling is accomplished. We are not certain that snakes have a sense of taste. The tongue is also a very delicate instrument of touch. Female serpents do not swallow their young to protect them, or for any other reason. No snake has a poisonous breath, the tails of all snakes are without venomous properties. Finally, the Milk Snake does not suck cow's milk. In the first place, its teeth are so sharp and numerous that the cow would be in a state of great pain should the snake attempt to draw milk. It is doubtful if any cow would remain passive under such circumstances. Then too, the capacity of such a serpent would not cause any noticeable diminution of output in a cow's daily produce, since the Milk Snake would drink only a small part of a glassful of the liquid.

In the United States, we are fortunate in having many serpents of all sizes, colors and habits. The more interesting specimens are, generally speaking, the larger snakes. These are hardier in captivity and easier to feed. Let us examine a few of the more common species of the eastern half of the country.

THE PILOT BLACKSNAKE is non-venomous, feeding mostly on rodents. It has a maximum length of eight feet and is a powerful constrictor. The author's specimens became quite docile in a short time, several of them feeding from the hand and showing no signs of resentment when handled. This particular snake likes society, for it is often found with venomous serpents, especially in hibernating dens. It may be recognized by its white lips, chin and throat. The ground color is a uniform black, with (in some cases) an obscure pattern of white. This is noticeable as "etchings" on the scales. The Pilot Blacksnake prefers woodlands, but may be found elsewhere. Its average length is about four or five feet.

The CORN SNAKE is also non-venomous, showing a preference for rodents. The maximum length is six feet. It is also a rather powerful constrictor. My specimens were a little nervous, but were healthy in captivity

and docile to the point of making excellent pets. The colors of this snake, combined with a healthy condition and ready feeding habits, cause it to be frequently sought as a pet. The color pattern consists of a bright red ground color varying to grey, with numerous (thirty or so) darker red blotches outlined in black. (These may be almost as light as the ground color.) The belly is checkered, often in black and white. The average length is about three feet.

The COMMON KING SNAKE is non-venomous. It feeds primarily on rodents and snakes, attaining a maximum length of six feet. It is another powerful constrictor, and an excellent pet. There is one drawback, however, King Snakes do not get along with other types of snakes and therefore must be kept isolated. They often feed on other snakes and are relatively immune to the venom of our American Pit-Vipers. I would caution the reader not to believe that the King Snake is the inveterate enemy of Rattlesnakes and Copperheads. These serpents merely form part of the King Snake's varied diet, along with harmless snakes, mammals, and other small animals. They resist capture strenuously, but calm down and become docile in a short time. Black with a chain-like pattern of white bands forms the coloration.

The INDIGO SNAKE is our largest non-venomous snake. Its feeding habits are not too well known. It should eat rodents and frogs. The maximum length is nine feet. Indigo Snakes are heavy-bodied reptiles. The usual color is black, of a softer hue than that of the Pilot Blacksnake. There is sometimes a bluish effect to the scales (hence indigo). The Indigo Snake usually makes a good pet. They are docile (although an occasional specimen may be irritable), feed regularly and often form part of a snake-charmer's outfit.

These snakes are well liked because of their favorable habits in captivity, but there are many more snakes good for a collection. They are too numerous to be mentioned here. Your local Zoo will be glad to help you make selections.

I cannot emphasize too strongly the necessity of personal contact with the snakes themselves. You cannot overcome the usual timidity or the initial fear that accompanies a new venture of this kind, unless there is actual contact with the snake. It is better, of course, to start under the guidance of someone who knows how to handle snakes. This will insure your learning correctly the method used in handling snakes and prevent the development of bad handling habits. Do not begin handling snakes about which you know nothing, since certain specimens demand greater gentleness than others and are easily irritated. Investigate the snake you intend to handle in advance of the actual contact with it. If in doubt, use library references or see your local Zoo authorities.

Cuban Yellow, Ground Boa.

VENOMOUS SERPENTS

How many species of serpents in the United States are dangerously poisonous to man? I doubt if there are many who can answer this question correctly. In truth, there are but four really dangerous types of snakes in our country. These are, by order of venom type:

Coral Snake—related in venom to the Cobra. Venom primarily neurotoxic. Two genera.

*Rattlesnake—predominately haemotoxic venom. There are many species. Two genera.

*Water moccasin—predominately haemotoxic venom, but has a high percentage of neurotoxins.

*Copperhead—predominately haemotoxic venom.

There are actually two groups of venomous snakes in the United States.

a. Coral Snakes (Elapidae)
   1. Micrurus (three species)
   2. Micruroides (one species)

b. Pit-Vipers (Crotalidae)
   1. Rattlesnakes
      a. Crotalus (This family contains the larger snakes.)
      b. Sistrurus (Venom of this group more toxic.)
   2. Water Moccasins and Copperheads
      a. Agkistrodon

*Pit-Vipers, closely allied to each other, venom variant.

The reason why I have classified these serpents by venom can best be explained by a few comments on the venom itself.

Neurotoxic venom is a complex and highly potent substance manufactured by a pair of specialized salivary glands, usually situated toward the base of the head. Its prime effect seems to be the destruction or inactivation of nerve cells and nerve tissue. It rapidly paralyzes the sympathetic nerve centers controlling the action of the heart and lungs.

Haemotoxis venom destroys red blood corpuscles and in some cases, with equal speed dissolves the capillary vessel walls. It is also potent and quick acting. Although the Pit-Vipers have essentially the same type of venom (haemotoxic), it does differ from species to species. Thus the Water Moccasin's venom differs from that of the Copperhead, although both belong to the genus Agkistrodon.

Neurotoxic venom, as you might venture to guess, is more dangerous than haemotoxic. We can combat that which works locally or effects the blood while travelling with it, but when atoxic substance paralyzes nerve cells or tissue, it is quite another story.

Because of the variability of the Pit-Vipers' venom, there has been developed what is known as a "polyvalent" antivenin, which is so made as to counteract the different types of Pit-Viper venoms. That is to say, a special antidote for a Rattlesnake, another for a Cottonmouth, etc., is not needed when a polyvalent serum is used.

Ross Allen extracting venom from a large rattlesnake at his famous Reptile Institute, Silver Springs, Florida.

Since the venomous serpents of our country are dangerous to a large extent, in proportion to their size, I might mention how the list would read if we went by order of size:

1. Rattlesnake (largest species)
2. Water Moccasin
3. Copperhead
4. Coral Snake

The only shift is the placing of the Coral Snake last instead of first, since it is much smaller than the other three.

These and only these four types (two groups) are really dangerously poisonous to man in the United States. There are, however, many species of Rattlesnake, approximatley fourteen of which are dangerous to man, and most of which are found in the Western half of the country. Herpetologists recognize four varieties (two genera) of Coral Snakes, three varieties of Copperhead and only one species of Water Moccasin.

Do not think that there are no other venomous snakes in our country besides the aforementioned groups. We have what are termed mildly venomous serpents. Such reptiles are poisonous, but because of certain factors, as size, degenerate poison apparatus, and so on,

are not considered dangerous to man. A few such snakes are:

Lyre Snake — Northern Cat-eyed Snake
Black-headed Snake — Arizona Vine Snake

There is no need to feel concerned over this group of serpents, for they are relatively harmless for practical purposes. Nevertheless, one should exercise normal caution. This group of reptiles is rear-fanged. That is, the poison-conducting teeth are located in the rear of the mouth. Most species occur in the Western half of the country.

In the identification of the four major types (two groups) of venomous serpents, color and pattern play a big part. Below are some helpful hints for identifying poisonous snakes.

The Coral Snakes are brilliantly colored, having red, yellow, and black bands. The yellow bands are relatively thin and border the black. The tip of the snout is black and is usually followed by one broad yellow band which crosses the head. The head is not distinct from the body. It is a very beautiful snake and usually quite inoffensive. There are two genera, the Arizona Coral Snake being placed in a separate genus. It is distinguished from the common Corals by having the first ring behind the yellow on the back of the head red instead of black. Despite their beauty, they have an extremely potent and destructive venom. They are not to be handled indiscriminantly.

Rattlesnakes have a variety of patterns. Concentrate on whether the snake has a rattle on the end of its tail. Prudence is to be exercised, since a number of completely harmless snakes, e.g., Blacksnake, vibrate the tail and if care is not taken, might be mistaken for a poisonous snake. A pit or opening between the eye and nose is an indication that the snake belongs to the Pit-Viper clan and is therefore poisonous. Do not try to see this in a wild specimen, as you may get too close. The rattle is never completely lost.

A coppery head and light brown body color, coupled with chestnut brown crossbands which look like inverted Y's, make the Copperhead a handsome snake. The number and form of the crossbands vary. There are usually about twenty bands. In the very young, the tail can be sulphur yellow. The head is triangular, the snout rather pointed.

Florida Pine Snake.

The Water Moccasin has an olive brown ground color, and in the vicinity of ten to fifteen fairly wide crossbands. The pattern is often poorly outlined in the larger specimens. When confronted, this snake stands its ground and throws open its mouth, revealing the more or less fluffy white interior. The name "Cottonmouth" is derived from this habit.

The poisonous serpents of our country are sluggish and slow to approach a human being. If given half a chance, they will usually glide away and let the intruder alone, provided he does nothing to irritate them. It is far better for the novice not to bother about poisonous snakes until he has had much experience handling the harmless ones and has read extensively about the temperament and other characteristics of venomous snakes.

READING LIST

Books:

Curran, C. H. and C. Kauffeld, *Snakes and Their Ways.*

Ditmars, Raymond L., *A Field Book of North American Snakes.*

Pope, Clifford H., *Snakes Alive and How They Live.*

Pope, C. H., *Snakes of the Northeastern States.*

Schmidt, K. P. and D. D. Davis, *Field Book of Snakes of the United States and Canada.*

Stebbins, R. C., *Amphibians and Reptiles of Western North America.*

Booklets:

Conant, Roger, *Reptiles and Amphibians of the Northeastern States.*

Hoopes, I., *Reptiles in the Home Zoo;* special publ. New England Mus. Nat. Hist. No. 1.

Kelly, H. A., *Snakes of Maryland.* (Check this book with local Zoo.)

Pamphlets:

Oliver, James A., *The Prevention and Treatment of Snakebite.*

Pope, Clifford H., *The Poisonous Snakes of the New World.*

Article:

Smith, H. M., *Snake Detection;* publ. Chic. Acad. Sci.

These are suggestions. There are, for most of the States, works on the reptiles of the particular region in which a person lives.

Field Trips to an Unusual Amphibian Habitat

ROBERT G. HUDSON,
Northeast High School,
Philadelphia, Pennsylvania

In using the frog as a representative form of amphibian life many biology teachers have been faced with the problem of securing live, healthy specimens for classroom demonstrations or laboratory dissections. Those desiring to maintain series of viable frog eggs for life-history studies or tadpoles for observations on amphibian metamorphosis are usually faced with the problem of personally procuring the study material. In rural areas where ponds and streams occur the adults and their eggs can be easily obtained, but in large cities the situation presents a predicament—a desire to undertake these studies but no readily available sources of material. To resolve this, it is suggested that the city biologist undertake field trips to the nearest railroad drainage ditches for some rewarding collecting.

In many cases, drainage ditches have been constructed to carry off rain from the roadbeds and also to divert small streams and spring run-offs which would normally flow across the right of way. These ditches usually support an abundance of aquatic plants and some vegetation along one or both banks. Recent collecting along these waterways in southeastern Pennsylvania (Philadelphia, Montgomery, and Bucks Counties) reveals them to be excellent collecting sites and in some cases an unexpected habitat for many amphibians. The most unusual example of this situation was the presence of Green Frogs and tadpoles near a railroad which traverses a heavily industrialized area of Philadelphia. The embankment and ditch were littered with rubbish but the flow of water was sufficient to prevent stagnation and pollution. A large colony of Fowler's Toads was also found along the same tracks. Further investigation revealed the toads to be breeding in concrete water reservoirs of a nearby jute mill.

Admittedly, the above are isolated instances of survival but if one follows the railroad tracks to the suburban sections of the city, the collecting becomes more varied and consistent. Areas where small springs drain into the ditch will produce a variety of salamanders as well as frogs. Under stones, logs, discarded railroad ties, and other hiding places I have found many of our local salamanders: Northern Dusky Salamander (*Desmognathus f. fuscus*), Red-backed Salamander (*Plethodon c. cinereus*), and Northern Two-lined Salamander (*Eurycea b. bislineata*). Salientians collected were: Fowler's Toad (*Bufo woodhousei fowleri*), Northern Spring Peeper (*Hyla c. crucifer*), Green Frog (*Rana clamitans melanota*), Leopard Frog (*Rana pipiens*), and Eastern Wood Frog (*Rana s. sylvatica*).

A jute mill reservoir in a heavily industrialized section of Philadelphia where Fowler's Toads breed. The toads live along the railroad behind the mill but migrate to these breeding ponds in the spring.

In addition to the adult forms, frog and salamander eggs can be secured if the field trip is made during their breeding seasons. My annual supply of Wood Frog eggs are collected from a drainage ditch in Bucks County. It was in pursuit of laboratory specimens during April of 1953 that I was afforded an unusual opportunity to observe a breeding habitat preference of the Spotted Salamander (*Ambystoma maculatum*). Eight large egg masses were found in a shallow ditch in comparison to only two in a nearby woodland pond. The pond seemingly offered ample cover and protection but the salamanders apparently preferred the ditch.

The aquatic life of the drainage ditch is by no means limited to amphibians for it also may contain leeches, crayfish, aquatic insect larvae and adults, minnows, and snakes. Where sufficient cover prevails, I have observed a profusion of bird life feeding on seeds and berries or drinking at streamside.

In some areas the water run-off is too rapid for the accumulation of permanent bodies of water. However, in most cases, where precipitation is moderate, the drainage ditches may help solve many biological supply problems. Upon investigation, other biology teachers may also find such sites excellent for collecting.

Books for Biologists

ELEMENTS OF ZOOLOGY. Storer, T. I. and Usinger, R. L. 552 pp. $5.50. McGraw-Hill Book Company, Inc. New York 36, New York. 1955.

This new work is a skillful abridgment of Storer's very successful *General Zoology*. Part I deals with animal biology-structure, physiology, reproduction, genetics, heredity, eecology and organic evolution. Part II outlines a classification of the Animal Kingdom and includes separate chapters on animal groups from protozoans to mankind. The excellent illustrations, many new, facilitate a clear understanding of the text. The incorporation of results of recent research in physiology, ecology, and evolution make it a valuable text and reference book.

THE HUMAN MACHINE. Charles W. Shilling. Captain, Medical Corps, United States Navy. 292 pp. $5.00. United States Naval Institute, Annapolis, Maryland. 1955.

Although this book was written primarily as a basic text in hygiene for the U. S. Naval Academy, it should interest the civilian public as well—particularly those interested in the field of biology. It presents the fundaments of anatomy and physiology in a clear and concise way. The style of presentation has been kept informal, with a minimum of medical and technical terminology. The many illustrations contribute to the understanding of the text.

Although some chapters might be considered "off limits" for certain civilian groups, as might be expected in a military text in hygiene, the book does embody basic information which is indespensible to an understanding of "The Human Machine."

CONSTRUCTION OF LABORATORY APPARATUS FOR SCHOOLS—Series II. 76 drawing sets. $8.00. UNESCO Columbia University Press. New York 27, New York. 1955.

These drawings and directions would be of value to a teacher or student interested in constructing laboratory apparatus. For schools on limited budgets these instructions would offer a solution to the ever present equipment problem at a reasonable cost.

Ultra-violet radiation as a method of water purification is effective and safe, according to a report given by several scientists to the annual meeting of the American Public Health Association in Buffalo. This method was recommended for travelers in foriegn countries, and hunting and fishing trips, as well as in emergency uses.

Hemophilia in the Human Female

MURL C. SHAWVER
Associate Professor of Biology
Madison College, Harrisonburg, Virginia

Has it been established that the disease hemophilia[1] exists in the human female? Hemophila has become widely known as a disease of the male. It has long been maintained that it is theoretically possible for this "bleeders disease" to occur in the human female. All of the introductory biology and genetics textbooks (college-level) examined by this writer identified hemophilia as a disease of the male inherited by sex-linkage. Some of the authors of these textbooks discuss the theoretical possibility of the disease in the female and its supposed lethal nature in prenatal life. A few authors say that no authentic human female hemophilics are known. However, it is now reported from England that the homozygous state in the human female has been substantiated by recent clinical and laboratory examinations on female members of a family which have been studied by British investigators since 1886 (13, 7, 11).

In this article it will be the purpose of the writer to (a) briefly survey the nature of hemophilia and (b) to summarize the discovery of hemophilia in the human female as reported in recent publications from Great Britain.

Nature of Hemophilia

The Hemophilia Foundation estimates that there are 40,000 human hemophilics in the United States (15). The disease hemophilia is also known in dogs (6). Clinical and laboratory characteristics of canine hemophilia are apparently identical with human hemophilia. Inheritance of this disease in dogs, as in man, is determined by a recessive sex-linked gene. A "bleeder" condition in Poland China swine has also been reported by Bogart and Muhrer (2). The clinical and laboratory reports on the swine, studied by these two investigators, revealed findings very similar to those found in human hemophilia. However, the inheritance of this hemophilia-like disease in swine was not by sex-linkage.

Humans suffering from hemophilia are popularly known as "bleeders." The disease is usually manifested at birth or during the first year of life and endures throughout the victim's lifetime (11). In some families the disease does not make its appearance until the second or sometimes as late as the tenth year (12). The coagulation time, is prolonged in hemophilia. Examination of hemophilic blood reveals a prolonged coagulation time of a few minutes over "normal" to an hour or more. The bleeding may occur in any part of the body, but the mouth, nose, and subcutaneous tissues are the most common sites. The bleeding may start spontaneously, but more often it starts as the result of trivial cuts or scratches. Surgical procedures such as tooth extractions and circumcisions sometimes result in bleeding that may be prolonged sufficiently to cause death.

Quick has described the normal coagulation of human blood as occurring in three fundamental steps: (a) the activation of thromboplastinogen; (b) the formation of thrombin; and (c) the conversion of fibrinogen to fibrin (8). The defect in the clotting mechanism of hemophilics is not clearly understood; however, Quick has presented evidence that hemophilia is due to the lack of available thromboplastin (thrombokinase) in the blood (8). Best and Taylor report that the fault in hemophilia lies in the first stage of the clotting process (prothrombin + thromboplastin + Ca → thrombin). The second stage of the clotting process (thrombin + fibrinogen → fibrin) is normal (1).

Hemophilic blood is not deficient in prothrombin. The platelets (thrombocytes) are

[1]This spelling widely used in the United States will be used in this article except in certain foreign reference notations where the spelling *haemophilia* is employed.

not reduced in number in the blood of the hemophilic, however, the platelets are less fragile than in normal blood. This has been considered a factor, but not the principal one, in the delayed coagulation of hemophilic blood. The primary factor in the delayed coagulation of the blood of the hemophilic is as stated above—"The lack of available thromboplastin" (8). Lung and brain tissue are good sources of thromboplastin, but it has been found in all tissues. Most of the thromboplastin of the blood is in the plasma. Plasmic thromboplastin is a lipoprotein (1). Contrary to earlier beliefs the platelets do not contain significant amounts of thromboplastin (1). Quick's investigations provide evidence that thromboplastin in the plasma is in an inactive form known as thromboplastinogen which can be changed to active thromboplastin by the action of substances from the platelets (8).

At times hemophilics may require surgery, have teeth pulled, or may suffer minor injuries. These incidents in the life of the hemophilic are more serious than in the persons not so afflicted. Whole blood transfusions of 100 cc at eight-hour intervals has been reported as the most effective therapeutic measure in hemophilic bleeding (3). With advances in the chemical partition of blood, control of the bleeding in the hemophilic victim is much more successful than formerly. Wright and others (14) report very effective management of the hemophilic patient by the use of Cohn's Fraction I (globulin substance). They report the case of a five-year-old boy with a coagulation time of fifty minutes. This was reduced, almost immediately, to thirteen minutes and maintained at this level for sixty-five hours by one intravenous transfusion of Cohn's Fraction I. These same authors report another case of a twenty-four-year-old farmer who had a ruptured spleen due to an automobile accident. This hemophilic patient's bleeding was successfully managed during major surgery, and the recovery period by repeated transfusions of whole blood and plasma. The patient was reported in "good health" thirty-eight months after surgery. A number of accounts relating how hemophilic patients are managed in traumatic and surgical crises tell of the use of Russell Viper venom in a dilution of 1:10,000; fibrin foam, placental extracts, and foreign protein sensitization. Ordinary preparations of tissue thromboplastin, were reported by one authority, as of no value in the management of hemophilic bleeding (3).

Hemophilia is a very ancient human disorder. It is known that the Hebrews during the second century A. D. were the possessors of considerable insight into the problem of bleeding in the sons of some women. Laws governing circumcision were altered by these ancient Hebrews so as to omit the operation in the later-born sons of a woman who had lost two sons due to bleeding. The ritual was not carried out for the sons of a sister of such a woman. If a man sired sons by a woman, other than the one who bore him sons who died of bleeding, these sons were treated as normal and were circumcised (12).

The gene for hemophilia in the human is located in the X-chromosome. It is believed that there are some twenty sex-linked human traits. The most common such human trait in the United States is red-green color-blindness occurring in about eight per cent of the men and about 0.5 per cent of the women (9). Stern reports that while most cases of hemophilia in man seem to follow the typical sex-linked mode, there have been pedigrees reported in which the condition was accounted for by a gene in an autosome (12).

Hemophilia in the Human Female

The conditions under which a hemophilic female would be expected are very rare. A carrier female and a hemophilic male could be the parents of a daughter with hemophilia. Snyder (10) points out that only eleven per cent of hemophilic males live to be twenty-two years old. Few daughters of "bleeders" would consider a "bleeder" a good prospect for a life mate. Therefore, very few such marriages have occurred. It has been reported by Snyder that only two such marriages are known. These two matings resulted in a total of two hemophilic sons and three normal daughters. In an effort to explain the apparent lack of female hemophilics, several possibilities have been postulated. It has been suggested that the combination of genes required to produce the homozygous hemophilic state

in the female is lethal to the developing embryo. It has also been suggested that the physiological environment of the female soma does not permit the duplicated genes to exert influences resulting in hemophilic symptoms (5).

A number of hemorrhagic disorders affect both the human sexes. Some of these disorders have the popular designation "bleeder," and certain of these are known to be hereditary. One such ailment, affecting both sexes, is thrombocytopenic purpura. A female with this type of purpura could be designated as a "bleeder" in her community. She could have brothers similarly affected and similarly identified. Therefore, since hemophilia is the "bleeder disorder" before the "public eye," more than any other disorder of blood coagulation, mistaken views, by the laymen, often result. However, laboratory tests reveal that the platelet count is helpful in distinguishing between certain disorders in blood clotting. One of the foremost symptoms of thrombocytopenic purpura is a reduced platelet count; in fact these small protoplasmic fragments may be almost completely absent from the blood. The hemophilic victim shows no platelet reduction from the "normal range" of 200,000 to 400,000 per cubic millimeter. There are a number of clinical and laboratory findings, other than platelet count, that are significant in the diagnosis of thrombocytopenic purpura and hemophilia. The details of these various symptoms and techniques are beyond the scope of this paper.

A family in England, whose bleeding tendencies have been the subject of hereditary investigation since 1886, has recently been restudied in an exceedingly thorough manner by Merskey (7, 13). It has been stated by Merskey that in order to establish the diagnosis of a female hemophilic, it would be necessary to show that her disease is clinically and pathologically indistinguishable from that which is found in the male; also it must be shown that her father was a hemophilic and her mother was a hemophilic carrier; in addition, all her sons have been proven hemophilics and her daughters hemophilic carriers (7).

Merskey (7) reports his studies of two daughters in the fifth generation of the family first studied for their bleeding tendencies by Treves in 1886 (13). The parents of these two members in the fifth generation were first cousins. Their father was a "bleeder" and their mother was a hemophilic carrier. There were twelve children born to this marriage, three sons, two of them hemophilic, nine daughters, five of whom had symptoms of hemophilia. Merskey made extensive studies of two of these daughters with bleeding tendencies. He reports that the clinical history and laboratory findings of the two women whom he studied were those of hemophilia, and he states that they appear to be the first human female subjects in whom the diagnosis of hemophilia has been substantiated.

The two sisters examined by Merskey were identified by him as V, 5 and V, 12 (7). This designation is used in this paper to present brief summaries of the two case histories. Merskey's case histories, as reported in this paper, are supplemented by reports, on the same two individuals, made in 1935 by Handley and Nussbrecker (4).

> **V, 5**—This woman was 67 years at the time Merskey studied her in 1950. She had a lifetime history of excessive bleeding even from small cuts. At age twenty she cut her hand on a bottle and the wound bled for five weeks. She began to menstruate at the age of eighteen but did not lose unusual quantities of blood at her periods until after age twenty-five. She had a tooth extracted in 1932 and the socket bled for a month. She had repeated nosebleed. This woman had many instances of hemorrhage into the elbows, knees, ankles, hips, and wrists. X-rays revealed abnormalities of wrist and elbow. In 1934 she suffered from menorrhagia for a six-month period. She had severe bleeding at her periods until the menopause at age 55.
>
> V, 5 was the mother of three children, two daughters who died in infancy and a hemophilic son. Her husband was not hemophilic and was not otherwise related to her. The son grew to manhood and is the father of two normal sons. After each of her confinements V,5 had bleeding over periods of four months.

V, 12—This woman, a younger sister of V, 5, was 57 years old in 1950 at the time Merskey obtained data about her bleeding tendencies. V, 12 always bled easily from small cuts, often for three or four days. Her periods lasted from ten days to a fortnight and were copious. She did not marry until she was in her late 30's. She had two miscarriages and one hemophilic son age fourteen at the time Merskey made his study of the family. After one of her miscarriages, she lost blood for twenty days. Teeth extractions have resulted in bleeding which lasted for two weeks.

In addition to the female members whose case histories have been summarized above, Merskey studied three adult male members in the sixth generation of the family. These males were nephews of V, 5, and V, 12. He reported that, on the basis of clinical and laboratory findings, the females, V, 5, and V, 12, demonstrated a disease, hemophilia, indistinguishable from the hemophilic state of the three males studied.

After Merskey had made his study of two females and three males of the family, he reports a similar study which was made by Dr. J. V. Dacie on V, 8 a sister of V, 5, and V, 12. Laboratory and clinical findings indicate that she too was hemophilic. V, 8 was reported as the mother of four sons, all hemophilic. When she learned that her two sisters had been diagnosed as hemophilic, she was aggrieved that she had not been classified with them, because she believed herself as much affected as her sister V, 12.

Merskey's report was based upon careful laboratory results. Bleeding time was not abnormally delayed, the platelet count was 217,000 per cu. mm. for the blood of V, 5, and 207,000 for the blood of V, 12. The coagulation time of both women was a little in excess of normal when measured with venous blood and considerably in excess of normal if measured with capillary blood. The male members of the family also displayed a type of hemophilia in which the coagulation time was only a little prolonged. The blood of V, 5 and V, 12 failed to correct the defect in coagulation of the blood of a known hemophilic.

So it appears that Merskey's investigations, substantiating the first female hemophilics, represents a peak of attainment in our knowledge about one of man's most interesting abnormalities. It has been said that hemophilia is the best known human hereditary ailment. One may predict that, in the near future, the sections on hemophilia in new and revised biology and genetics textbooks will reflect the pioneering work of Merskey in England on female hemophilia.

REFERENCES CITED

1. Best, C. H., Taylor, N. B., *The Physiological Basis of Medical Practice*, Williams and Wilkius Company, Baltimore, 1330. 112-124.
2. Bogart, R., and Muhrer, M. E., The Inheritance of a Hemophilia-like Condition in Swine, *The Journal of Heredity*, 33; 59-64, Feb., 1942.
3. Conn, Howard F., Editor, *Current Therapy 1951*, W. B. Saunders Company, Philadelphia, 699 pp. 1951. p. 156.
4. Handley, R. S., and Nussbrecker, A. M., Hereditary Pseudo-Haemophilia, *The Quarterly Journal of Medicine*, 4 N. S.: 165-178. 1935.
5. Hill, J. Ben and Hill, Helen D., *Genetics and Human Heredity*, McGraw-Hill Book Company, New York, 526 pp., 1955. p. 494.
6. Hutt, F. B., Rickard, C. G., and Field, R. A., Sex-Linked Haemophilia in Dogs, *The Journal of Heredity*, 39: 3-9. Jan., 1948.
7. Merskey, Clarence, The Occurrence of Haemophilia in the Human Female, *Quarterly Journal of Medicine*, N. S., 20, 299-312. 1951.
8. Quick, A. J., Studies on the Enigma of the Hemostatic Dysfunction of Hemophilia. *American Journal of the Medical Sciences*, N. S., 214, 272-279.
9. Sinnott, Edmund W., Dunn, L. C., Dobzbansky, Th., *Principles of Genetics, 4th Ed.*, McGraw-Hill Book Company, Inc., New York, 505 pp. 1950. p. 182.
10. Snyder, Laurence H., *The Principles of Heredity*, D. C. Heath and Co., Boston, 515 pp. 1951. p. 86.
11. Sorsby, Arnold, *Clinical Genetics*, C. V. Mosby Company, St. Louis, 580 pp. 1953. 476.
12. Stern, Curt, *Principles of Human Genetics*, W. H. Freeman and Company, San Francisco. 617, 1949. 189.
13. Treves, Frederick, A Case of Haemophilia: Pedigree Through Five Generations, Lancet, 2:533, 1886.
14. Wright, Claude, Doan, Charles A., Dodd, Verne A., and Thomas, James D., Hemophilia: Current Theories and Successful Medical Management in Traumatic and Surgical Crises, *The Journal of Laboratory and Clinical Medicine*, 33: 708-719. 1948.
15. The Hemophilia Foundation, *The Journal of Heredity*, 42. p. 74. March-April, 1951.

An Exotic Aspect of Bacterial Spores

FRANK E. WOLF
Plymouth Teachers College
Plymouth, New Hampshire

The main avenue of approach in examining the nature of bacterial spores is provided by the challenging statement, "Dr. Charles B. Lipman . . . reported . . . he had recovered bacteria from rocks which had been deposited a million years ago."[1] If bacteria could withstand the severe environmental conditions imposed by rocks, some knowledge may be gained about their spore-forming ability. Dr. Lipman's work on meteorites, rather than stony rocks, was used, however, because it is a later work.

Dr. Lipman's six-year experiments with aerolites, briefly abstracted, is as follows.[2] Samples of meteorites were washed with soap and water, and brushed; rinsed in distilled water; placed in a bactericide for several hours; rinsed in 95 percent alcohol; and flamed until the alcohol stopped burning. Other procedures followed[3] sterile technique when possible and aseptic otherwise. Specimens were then dropped into large media flasks for long periods (up to five months) of incubation. If growth occurred, sterilization was again attempted. If no growth occurred in the large flasks, the specimen was crushed and the powdered sample placed in a series of small media flasks. This step was done in a sterile inoculation chamber for which control flasks were provided. The small flasks were then incubated and examined for bacterial growth presumed to have come from within the specimen.

An examination of the procedure reveals the following. Samples from the small flasks often showed bacilli and cocci with some in spore forms. Some flasks were barren. The controls only occasionally grew a mold colony, but bacteria observed in the small flasks did not occur in the controls. Therefore, the technique seems to be acceptable, especially since ordinary transplanting technique requires moving the flaming needle through the air for short distances. Too many flasks grew bacteria for them to be contaminants, unless the operations were performed by a rank amateur. Since the meteorites were so drastically sterilized, some forms may have been killed and lost for observation.

In addition to the bacilli and cocci forms, one giant form called *megatherium* (twelve microns by five microns) was found. One colony had irregular bacilli and cocci forms in it. This colony grew well in an autotrophic medium. Although these forms started as bacilli and cocci, through subculturing they became perfect cocci. At 5° C. the cocci reverted and again produced polygonal shaped colonies of two types: branching variable bacilli and cocci forms.

These remarkable forms could not have come from any source other than the meteorite. This evidence renders more tenable the "cosmozoic hypothesis of Kelvin that life could reach us from some extraterrestrial source."[3] Jean disqualified Kelvin's theory, "because the heat of a meteorite would destroy bacteria." This is an extraneous argument, but the facts about meteors, concerning their temperature in reference to bacteria, do concern us.

Facts about meteors gathered at the Hayden Planetarium are as follows: Meteors may burn for very short periods, i.e., twenty miles of travel. The thickening atmosphere of the earth slows meteors as they enter our atmosphere leaving unburned parts. Some travel slowly enough not to burn at all. Our atmosphere is too short to give them all time to burn through and their centers may be cold. Meteors may be lukewarm or freezing when they hit earth. Meteors heated in a forge lose their characteristics.

[1] Frank Jean, and Others, *Man and His Biological World*. New York: Ginn and Company, 1944. p. 279.
[2] Charles B. Lipman, *Are There Living Bacteria in Stony Meteorites?* New York: American Museum Novitates, No. 588, December 31, 1932.
[3] Jean, *op. cit.*, p. 8.

It is fair to assume, then, that spores could survive in those meteors which do not undergo excessive temperature changes. It is also fair to infer that Dr. Lipman's meteorites did not undergo excessive heating or they would not have been recognized as meteorites. Another point to sustain the endurance ability of bacteria is, "Spores may withstand hours of boiling or survive treatment with strong carbolic acid."[4]

The argument that bacteria could not survive in meteors due to the deficiencies of organic matter is in part refuted by the autotrophic form cultivated by Dr. Lipman. Other evidence that this argument is not necessarily valid may be found in another of Dr. Lipman's papers. "The per cent of combined nitrogen in seven sample meteors was: .0052, .0064, .0036, .0048, .0016, .0025, .0034. This represents one-tenth of the nitrogen in soils classified as nitrogen poor. The nitrogen was found in the form of organic nitrogen. Nitrate, nitrite, and ammonia tests were negative, indicating that unknown constituents exist. While this amount of nitrogen is small, it is ample for a small bacterial population."[5]

It is well understood that there are different ways of interpreting Dr. Lipman's work. It is not my purpose to go into all the ramifications of the problem because only a particular aspect concerns us, i.e., the nature of the spores. Dr. Lipman concludes that, " . . . the meteorites bring bacteria with them probably as spores but not necessarily so."[6] It would appear, however, that the bacteria gathered were in spore form, because there were so few bacteria. If all the trapped bacteria could have survived there would have been a plentiful harvest. Therefore, only those in a spore stage could have endured. Since bacteria are everywhere and only some of the meteorites had spores, we may infer that the presence of spores was accidental for those particular bacteria.

Various authors disagree on the spore formation ability of bacteria. Some believe that bacteria "willfully" go into a spore stage when adverse conditions present themselves. Others believe that when adverse conditions present themselves only those bacteria which happen to be in spore forms will "accidentally" survive. The latter conclusion drawn from Dr. Lipman's work indicates that the accident theory is the more valid. About all that can be definitely said is that bacterial spores can withstand a great deal of extremes in their environment. Similarly, in spite of the drastic measures taken to free the surface of the meteorites from bacteria some meteorites could not be cleaned of surface bacteria at all.

The literature on the subject, taken in light of Lipman's work and my own experience, points to three conclusions. One, *some kinds* of bacteria, as conditions *gradually* become unfavorable, form spores; that is, under the microscope a fresh culture may show a few spores among many bacteria. Later, the culture may show many spores; finally, it may show all spores. Two, some bacteria produce few spores or none at all under certain conditions.[7] Three, of those bacteria which can form spores, a *sudden* change in conditions will enable only those bacteria which happen to be in the spore state to survive.

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[4] *Ibid.*, p. 279.

[5] Charles B. Lipman, *The Discovery of Combined Nitrogen in Stony Meteors.* New York: American Museum Novitates, No. 589, December 31, 1932.

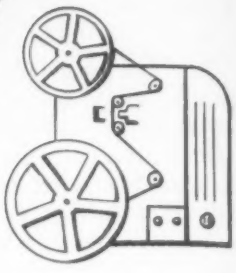
[6] Charles B. Lipman, *Are There Living Bacteria in Stony Meteorites?* New York: American Museum Novitates, No. 588, December 31, 1932. p. 17.

[7] War Department Technical Manual, *Methods for Laboratory Technicians,* Technical Manual 8-227, October, 1946, p. 286.

Two harmful compounds that retard the growth of chicks and cause digestive trouble in cattle, sheep and goats have been extracted from alfalfa, Dr. C. Ray Thompson, a biochemist of the Western Regional Research Laboratory, at Albany, California, told members of the American Chemical Society in Kansas City. The substances were identified as plant saponins—complex lather-forming plant materials—long suspected of upsetting the digestion of ruminants and stunting chicks.

You wouldn't think that finely-ground granite would be a good fertilizer for various plants, but a series of research studies by Prof. Charles J. Lyon of the Dartmouth College Botany Department demonstrate positively that it is. The effectiveness of feldspar and mica as sources of potassium fertilizer for a variety of plants was described.

A-V NEWS



Emery L. Will, State University Teachers College, Oneonta, New York

. . . . About 30 species of trees are shown season by season in Dr. William Harlow's newest film release, TREE PORTRAITS. Of particular interest to teachers in the northeastern states, the film shows how to identify trees by their leaves, flowers, fruits, twigs, buds and bark. Time-lapse scenes of trees in spring, and data on the importance and distribution of trees in New York State are included. Address inquiries to Dr. Harlow at the State University College of Forestry, Syracuse University, Syracuse, N. Y.

. . . . Newest listing of U. S. Department of Agriculture films and filmstrips is Agriculture Handbook No. 14, "Motion Pictures of the U. S. Department of Agriculture" (1954). You can obtain a copy of this descriptive listing by sending $.25 to the Supt. of Documents, Government Printing Office, Washington 25, D. C.

. . . . The USDA informs us that the negative of REALM OF THE WILD, which has been an outstanding wildlife film, is rapidly deteriorating and soon will be unusable for further printing. If you wish to purchase a print, it is suggested that you make your request to United World Films, Inc., 1445 Park Avenue, New York 29, N. Y.

. . . . The Motion Picture Service of the USDA offers a stock scene library service to groups and individuals interested in using agricultural film footage in the production of films and television programs. Volume II of the "TV Film Clip Library Scene List" became available in December. Address inquiries to: U. S. Department of Agriculture, Office of Information, Motion Picture Service, Washington 25, D. C.

. . . . Requests for assistance in the production of television programs have been received by the Audio-Visual Committee. With your cooperation and suggestions, a clearing house for sample scripts, etc. for biology TV programs might be set up. A post card or letter addressed to the Audio-Visual Committee of the N.A.B.T., in care of Dr. Emery L. Will, State University Teachers College, Oneonta, New York, would help determine a course of action. Please let us know of your opinion.

. . . . Teachers with limited science budgets, and cytologists should be interested in two new products from the American Optical Company. Already on the market is a low-priced laboratory microscope, with a single adjustment and two color-marked objectives, which is surprisingly easy to use. New possibilities for cytological work should open up with AO's forthcoming four-needle micromanipulator.

. . . . The use of experimental animals in medical research is the subject of a 20-minute color film, WHICH FATE? It tells of the work of research scientists, and of ways in which stray dogs are used in the development of better diets, and of new surgical techniques for the benefit of mankind. Requests for loan prints should be made to Ralph Rohweder, Executive Secretary, Nation Society for Medical Research, 208 N. Wells Street, Chicago 6, Illinois.

. . . . New and outstanding films of the past few months were shown at the Waldorf-Astoria Hotel in New York City during the period, April 4-8. The occasion was the second annual American Film Assembly and the second Golden Reel Film Festival. For teachers in the New York City area, this was an opportunity to preview many fine biology films.

. . . . The latest materials and techniques for audio-visual instruction were demonstrated

April 18-22, at the NEA Department of Audio-Visual Instruction Annual Conference, in Los Angeles, California. Information can be obtained from the D.A.V.I., 1201 Sixteenth Street, N. W., Washington 8, D. C.

. . . . Recent film releases:

FLOWERING DESERT. 11 min., sd., color. The desert and its climates; the coming of spring to the desert fauna and flora. Bailey Films, 6509 De Longpre Avenue, Hollywood 28, California.

THE GRASSHOPPER: A TYPICAL INSECT. 6 min., sd., color. Body structure, life cycle and economic importance. Intermediate–junior high. Coronet Films, 65 E. South Water Street, Chicago 1, Illinois.

LET'S TAKE A WALK ALONG THE BROOK. 10 min., sd., color. Story of a field trip for young children. Primary. Gateway Productions, 1859 Powell Street, San Francisco 11, California.

THE HONEYBEE: A SOCIAL INSECT. 6 min., sd., color. Communal living, division of labor, life cycle and economic importance. Intermediate–junior high. Coronet.

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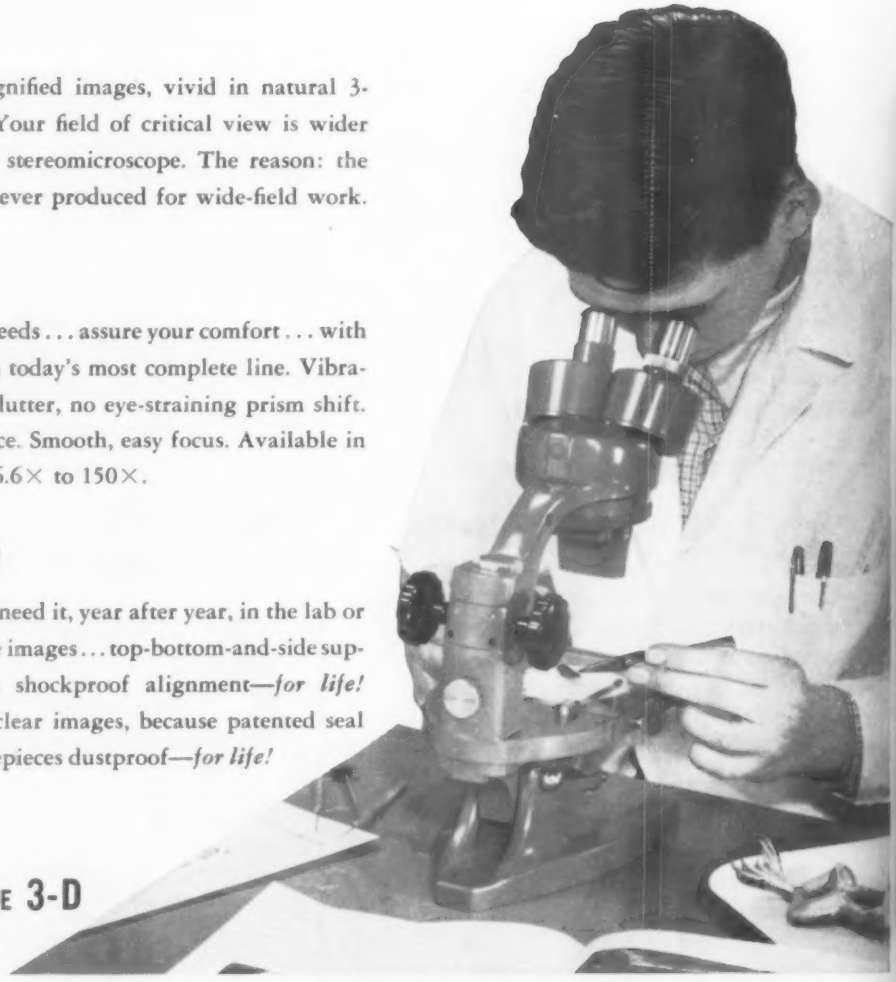

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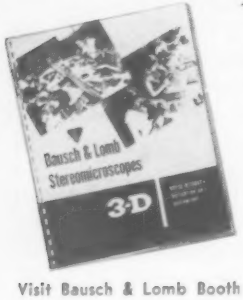

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